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IS 7657-1 (1975): Starter Ring Gears for Internal Combustion Engines, Part I: Gears for Inertia and Solenoid Pre-engaged Starters [TED 2: Automotive Primemovers]

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Indian Standard

SPECIFICATION FOR STARTER RING GEARS FOR INTERNAL COMBUSTION ENGINES

PART I GEARS FOR INERTIA AND SOLENOID PRE-ENGAGED STARTERS

Internal Combustion Engines Sectional Committee, EDC 14; Panel for Flywheel Ring Gears, EDC 14:P1 [Ref: Doc: EDC 14 (2318)]

1. Scope — Specifies gear profile, dimensions, material and other requirements for involute spur ring gears for inertia or pre-engaged starters having hardened pinions used for starting internal combustion engines.

1.1 This is also applicable to engines used on road vehicles.

1.2 This standard is not applicable to ring gears for heavy duty applications which generally have 4 module pinions and gears.

2. Terminology

2.1 *Inertia Starter* — A starter whose power is derived from the kinetic energy of a rotating mass.

2.2 *Inertia Engagement* — Engagement effected by axial movement of the pinion along a helically splined sleeve, due to inertia of the pinion when the shaft is rotated.

2.3 *Solenoid Pre-engagement* — Engagement of pinion effected through a lever external to the motor carcase and operated by a power device, such as a solenoid.

2.4 *Inboard Starter* — A starter so constructed that pinion and ring gear engagement is effected by movement of the pinion towards the starter motor.

2.5 *Outboard Starter* — A starter so constructed that pinion and ring gear engagement is effected by movement of the pinion away from the starter.

3. Dimensions and Tolerances — Gear profile and dimensions are given in Table 1. Other dimensions are subject to agreement between the purchaser and supplier. The tolerances shall be specified according to any of the methods given in Table 2.

3.1 *Face Width of Teeth* — Recommended values for interchangeability between inboard inertia starters and outboards pre-engaged starters are as follows:

Type of Engine	*Starting Torque*	*Width*
	Nm	mm
Small petrol engines	Up to 20	9·5
Medium and large petrol engines	Above 20 up to 35	11
Medium and large diesel engines	Above 35	13, 16 or 19

3.2 *Tooth Chamfer* — Tooth chamfer is generally required for 3 and 2·5 module ring gears and is essential when inertia type starters are used. When chamfering is required, non-pressure flank should be chamfered on both sides to allow for both inertia and pre-engaged type starters (*see* figure in Table 1).

3.2.1 Ring gears of 2·25 module may not be required to be chamfered generally since they are of pre-engaged type.

3.3 *Working Clearance* — Shall be 0·13 mm minimum backlash under adverse tolerance conditions. For shrunk on type ring gears an additional diametral allowance of 0·5 mm shall be provided.

4. Material — Steel C40 or C45 according to IS : 5517-1969 'Specification for steels for hardening and tempering'. The sulphur content for these steels may go up to 0·06 percent maximum.

Adopted 29 April 1975	© July 1975, ISI	[redacted] Gr 2

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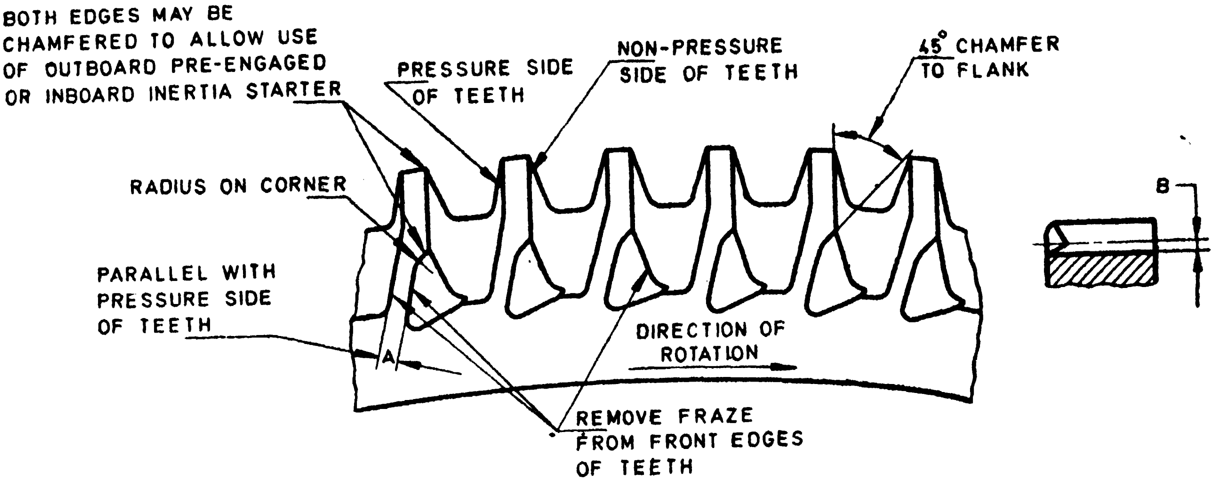
TABLE 1 DIMENSIONS FOR RING GEARS FOR INERTIA AND SOLENOID PRE-ENGAGED STARTERS

(*Clauses* 3 *and* 3.2)

All dimensions in millimetres.


BOTH EDGES MAY BE CHAMFERED TO ALLOW USE OF OUTBOARD PRE-ENGAGED OR INBOARD INERTIA STARTER
PRESSURE SIDE OF TEETH
NON-PRESSURE SIDE OF TEETH
45° CHAMFER TO FLANK
RADIUS ON CORNER
PARALLEL WITH PRESSURE SIDE OF TEETH
A
DIRECTION OF ROTATION
REMOVE FRAZE FROM FRONT EDGES OF TEETH
B

Module	Dimensions	
	A	*B*
2·25 to 2·5	$1{\cdot}15^{+0{\cdot}13}_{0}$	0·8
2·5 to 3	$1{\cdot}15^{+0{\cdot}13}_{0}$	0·8
3 to 4	$1{\cdot}65^{+0{\cdot}25}_{0}$	1·0

TABLE 2 RECOMMENDED METHODS OF MEASUREMENTS FOR STARTER RING GEARS

(*Clause* 3)

All dimensions in millimetres.

		METHOD I **Span Over Given Number of Teeth* Base Tangent Length**	**METHOD II** **Dimensions Over Roller Using ϕ Roller**	**METHOD III** **Chordal Measurement**	
				Chordal Height	Chordal Thickness
Before shrink fit	*Max*				
	Min				
After shrink fit† (For a nominal shrinkage of 0·5 mm)‡	*Max*				
	Min				

*Given number of teeth depends on total number of teeth on ring gear and pressure angle.

†Not applicable for bolted type of ring gears.

‡Recommended practice is to have 0·028 mm shrinkage allowance per 25 mm of inside diameter (to maintain a hoop stress of not more than 227·5 N/mm^2).

5. Designation — Shall include:

a) Name,
b) Symbol I or PE for inertia or pre-engaged type,
c) Module, and
d) No. of this standard.

Example:

A ring gear for pre-engaged starter of module 3 shall be designated as:

Ring Gear PE 3 IS : 7657 (Part I)

6. Hardness — The hardening of the tooth engaging face on the pitch line shall be as follows:

Module	*Hardness, HV*
2·25 to 2·5	520 to 600
2·5 to 3	520 to 600
3 to 4	470 to 550

6.1 Hardness values other than those specified in **6** may be used subject to agreement between the purchaser and the manufacturer.

6.2 The minimum depth of hardness shall be 2·5 mm over the whole profile.

7. Assembly on Flywheel

7.1 *Manual Gear Box Vehicles* — The gear ring can be bolted on to the flywheel or can be shrunk on. With shrunk on gear rings this operation is sometimes combined with tempering. If tempering has been done separately, the ring should not be heated to more than 200°C to avoid softening of gear teeth. This is of special importance when replacement rings are fitted by service stations. A shoulder or step on the flywheel is recommended to ensure that the ring is located equally with the correct out of mesh clearance when fitted to the engine.

7.2 *Automatic Gear Box Vehicles* — The ring gear can be bolted or shrunk on, but it is also common practice for the ring gear to be welded to a flexible plate. In the latter case, the ring gear is made to the finished size since there is no expansion of the ring during fitting. It should be noted that the inherently more flexible location usually results in a higher noise level, although wear rates can be similar to that of the other methods. Particular attention should be paid to accuracy of location.

EXPLANATORY NOTE

This standard covers ring gears for automobile applications for inertia and solenoid pre-engaged starters and does not cover axial and coaxial starters which are used for heavy duty applications. Ring gears for axial and coaxial starters are covered in Part II of this standard.

Requirements of this standard are so chosen that they meet the requirements of self-starter endurance test specified in IS : 3141-1965 'Specification for starters for automobiles'.

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IS 7657 (PART 1) : 1975 SPECIFICATION FOR STARTER RING GEARS FOR INTERNAL COMBUSTION ENGINES

PART 1 GEARS FOR INERTIA AND SOLENOID PRE-ENGAGED STARTERS

(*Page* 2, *Table* 1) — Insert the following dimensions in the table:

Module	**Dimensions**	
	A	*B*
1.75 to 2.0	$1.15^{+0.13}_{0}$	0.8

(TED 2)

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